



GS2974A HD-LINX™ III Adaptive Cable Equalizer

Features

- SMPTE 424M, SMPTE 292M and SMPTE 259M compliant
- Automatic cable equalization
- 0.3UI Maximum Output Jitter at 2.97Gb/s
- Multi-standard operation from 143Mb/s to 2.97Gb/s
- Supports DVB-ASI at 270Mb/s
- Small footprint (4mm x 4mm)
- Pb-free and RoHS compliant
- Manual bypass (useful for low data rates with slow rise/fall times)
- Performance optimized for 1.485Gb/s and 2.97Gb/s
- Typical equalized length of Belden 1694A cable: 120m at 2.97Gb/s, 200m at 1.485Gb/s, and 350m at 270Mb/s
- 50Ω differential output (internal 50Ω pull-ups)
- Programmable mute based on max cable length adjust
- Single 3.3V power supply operation
- Operating temperature range: 0°C to +70°C

Applications

- SMPTE 424M, SMPTE 292M and SMPTE 259M Coaxial Cable Serial Digital Interfaces.

Description

The GS2974A is a high-speed BiCMOS integrated circuit designed to equalize and restore signals received over 75Ω co-axial cable.

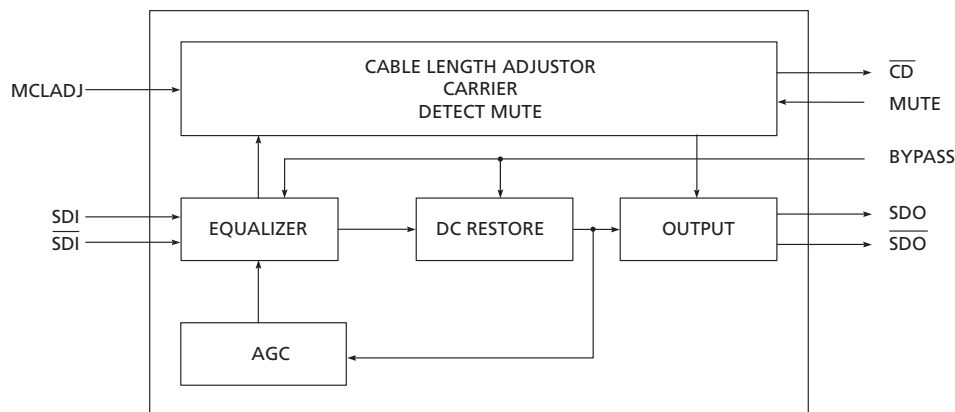
The GS2974A is designed to support SMPTE 424M, SMPTE 292M and SMPTE 259M, and is optimized for performance at 1.485Gb/s and 2.97Gb/s.

The GS2974A features DC restoration to compensate for the DC content of SMPTE pathological test patterns.

A voltage programmable mute threshold (MCLADJ), applicable for SD mode (refer to [Section 4.3](#)), is included to allow muting of the GS2974A output when an approximate selected cable length is reached for SMPTE 259M signals. This feature allows the GS2974A to distinguish between low amplitude SD-SDI signals and noise at the input of the device. The serial digital outputs of the GS2974A may be forced to a mute state by applying a voltage to the MUTE pin.

Power consumption is typically 215mW using a 3.3V power supply. The GS2974A is lead-free, and the encapsulation compound does not contain halogenated flame retardant.

This component and all homogeneous subcomponents are RoHS compliant.



GS2974A Functional Block Diagram

Revision History

| Version | ECR | PCN | Date | Changes and/or Modifications |
|---------|--------|-----|---------------|--|
| 3 | 151331 | - | January 2009 | Added 2500pc reel size to 6.6 Ordering Information. Changed the Output Voltage Swing from 550mV _{p-p} to 600mV _{p-p} in Table 2-2: AC Electrical Characteristics. |
| 2 | 149719 | - | April 2008 | Added "0.3UI Maximum Output Jitter at 2.97Gb/s" to Features Section and Table 2-2: AC Electrical Characteristics. Changed cables lengths from 100 to 120 and 400 to 350 in Section 4. Detailed Description. Re-wrote Section 4.3 Programmable Maximum Cable Length Adjust (MCLADJ). Added Tape & Reel to 6.6 Ordering Information. |
| 1 | 145131 | - | May 2007 | Converted to Data Sheet. |
| 0 | 144247 | - | February 2007 | Converted to Preliminary Data Sheet. Removed 'Proprietary and Confidential' footer. Modified DC Electrical Characteristics and AC Electrical Characteristics table. Added section 6.4 Marking Diagram. |
| A | 143102 | - | December 2006 | New Document. |

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1. Pin Out

1.1 GS2974A Pin Assignment

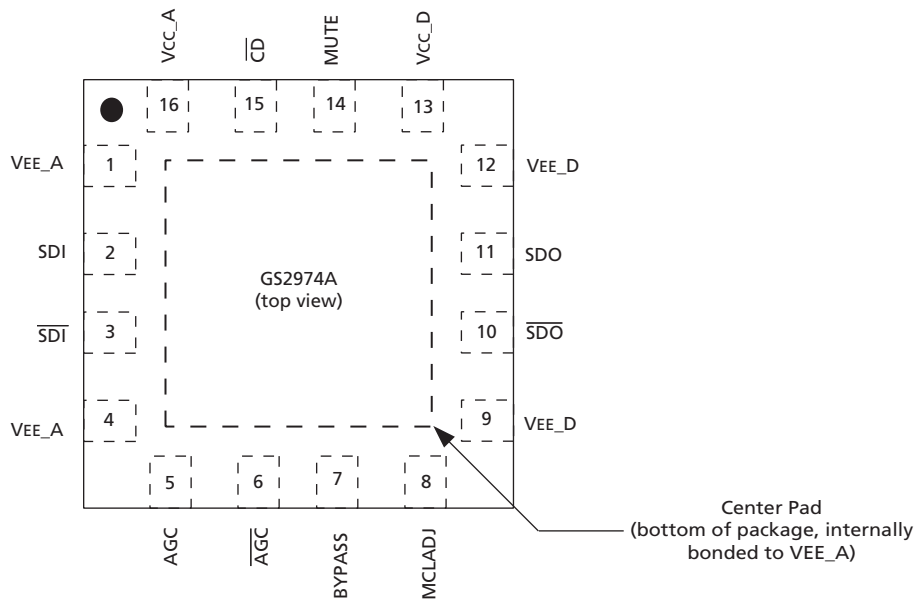


Figure 1-1: 16-Pin QFN

1.2 GS2974A Pin Descriptions

Table 1-1: GS2974A Pin Descriptions

| Pin Number | Name | Timing | Type | Description |
|------------|------------------------------|-----------------|-------|--|
| 1, 4 | VEE_A | Analog | Power | Most negative power supply for analog circuitry. Connect to GND. |
| 2, 3 | SDI, $\overline{\text{SDI}}$ | Analog | Input | Serial digital differential input. |
| 5, 6 | AGC, $\overline{\text{AGC}}$ | Analog | – | External AGC capacitor. Connect pin 5 and pin 6 together as shown in the Typical Application Circuit on page 12 . |
| 7 | BYPASS | Not Synchronous | Input | Forces the Equalizing and DC RESTORE stages into bypass mode when HIGH. No equalization occurs in this mode. |
| 8 | MCLADJ | Analog | Input | Maximum cable length adjust. Adjusts the approximate maximum amount of cable to be equalized. See Section 4.3 . and Section 4.4 |
| 9 | VEE_D | Analog | Power | Most negative power supply for the digital circuitry and output buffer. Connect to GND. |

Table 1-1: GS2974A Pin Descriptions (Continued)

| Pin Number | Name | Timing | Type | Description |
|------------|------------------------|-----------------|--------|---|
| 10, 11 | \overline{SDO} , SDO | Analog | Output | Equalized serial digital differential output. |
| 12 | VEE_D | Analog | Power | Most negative power supply for the digital circuitry and output buffer. Connect to GND. |
| 13 | VCC_D | Analog | Power | Most positive power supply for the digital I/O pins of the device. Connect to +3.3V DC. |
| 14 | MUTE | Not Synchronous | Input | CONTROL SIGNAL INPUT levels are LVCMOS/LVTTL compatible. (3.3V Tolerant) Controls output behaviour on SDO and \overline{SDO} See Section 4.4 . |
| 15 | \overline{CD} | Not Synchronous | Output | STATUS SIGNAL OUTPUT Signal levels are LVCMOS/LVTTL compatible. Indicates the presence of a good input signal. See Section 4.4 . |
| 16 | VCC_A | Analog | Power | Most positive power supply for the analog circuitry of the device. Connect to +3.3V DC. |
| – | Center Pad | – | Power | Internally bonded to VEE_A. |

2. Electrical Characteristics

2.1 Absolute Maximum Ratings

| Parameter | Value |
|---------------------------------|---------------------------------|
| Supply Voltage | -0.3V to +3.6 VDC |
| Input ESD Voltage | 2kV |
| Storage Temperature Range | -50°C < T _s < 125°C |
| Input Voltage Range (any input) | -0.3 to (V _{CC} +0.3)V |
| Operating Temperature Range | 0°C to 70°C |
| Solder Reflow Temperature | 260°C |

2.2 DC Electrical Characteristics

Table 2-1: DC Electrical Characteristics

V_{CC} = 3.3V ±5%, T_A = 0°C to 70°C, unless otherwise shown

| Parameter | Symbol | Conditions | Min | Typ | Max | Units | Notes |
|--|---------------------|---------------------------|-------|--|-------|-------|-------|
| Supply Voltage | V _{CC} | – | 3.135 | 3.3 | 3.465 | V | ±5% |
| Power Consumption | P _D | T _A = 25°C | – | 215 | 343 | mW | – |
| Supply Current | I _s | T _A = 25°C | – | 65 | 98 | mA | – |
| Output Common Mode Voltage | V _{CMOUT} | T _A = 25°C | – | V _{CC} - ΔV _{SDO} /2 | – | V | – |
| Input Common Mode Voltage | V _{CMIN} | T _A = 25°C | – | 1.75 | – | V | – |
| MCLADJ DC Voltage (to mute signal) | – | 0m, T _A = 25°C | – | 3.2 | – | V | – |
| MCLADJ Range | – | T _A = 25°C | – | 0.5 | – | V | – |
| CD Output Voltage | V _{CD(OH)} | Carrier not present | 2.4 | – | – | V | – |
| | V _{CD(OL)} | Carrier present | – | – | 0.4 | V | – |
| Mute Input Voltage Required to Force Outputs to Mute | V _{Mute} | Min to Mute | 2.0 | – | – | V | – |
| Mute Input Voltage Required to Force Outputs Active | V _{Mute} | Max to Activate | – | – | 0.8 | V | – |

2.3 AC Electrical Characteristics

Table 2-2: AC Electrical Characteristics

$V_{CC} = 3.3V \pm 5\%$, $T_A = 0^\circ C$ to $70^\circ C$, unless otherwise shown

| Parameter | Symbol | Conditions | Min | Typ | Max | Units | Notes |
|---|------------------|--|-----|------|------|-------------------|-------|
| Serial input data rate | DR_{SDO} | – | 143 | – | 2970 | Mb/s | – |
| Input Voltage Swing | ΔV_{SDI} | $T_A = 25^\circ C$, differential, 270Mb/s and 1.485Gb/s | 720 | 800 | 950 | mV _{p-p} | 1 |
| | | $T_A = 25^\circ C$, differential, 2.97Gb/s | 720 | 800 | 880 | mV _{p-p} | 1 |
| Output Voltage Swing | ΔV_{SDO} | 100 Ω load, $T_A = 25^\circ C$, differential | 600 | 750 | 1050 | mV _{p-p} | – |
| Output Jitter of Various Cable Lengths and Data Rates | – | 270Mb/s Belden 1694A: 0-300m | – | – | 0.2 | UI | 2,5 |
| | – | 270Mb/s Belden 1694A: 300-350m | – | 0.2 | – | UI | 4,5 |
| | – | 1.485Gb/s Belden 1694A: 0-140m | – | – | 0.25 | UI | 2,5 |
| | – | 1.485Gb/s Belden 1694A: 140-200m | – | 0.3 | – | UI | 4,5 |
| | – | 2.97Gb/s Belden 1694A: 0-70m | – | – | 0.3 | UI | 2,5 |
| | – | 2.97Gb/s Belden 1694A: 70-120m | – | 0.3 | – | UI | 4,5 |
| Output Rise/Fall time | – | 20% - 80% | 40 | 80 | 220 | ps | – |
| Mismatch in rise/fall time | – | – | – | – | 30 | ps | – |
| Duty cycle distortion | – | – | – | – | 30 | ps | – |
| Overshoot | – | – | – | – | 10 | % | – |
| Input Return Loss | – | – | 15 | 21 | – | dB | 3 |
| Input Resistance | – | single ended | – | 1.52 | – | k Ω | – |
| Input Capacitance | – | single ended | – | 1 | – | pF | – |
| Output Resistance | – | single ended | – | 50 | – | Ω | – |

NOTES:

- 0m cable length.
- All parts were production tested. In order to guarantee jitter over the full range of specification ($V_{CC} = 3.3V \pm 5\%$, $T_A = 0^\circ C$ to $70^\circ C$, and 720-880mV launch swing from the SDI cable driver) the recommended applications circuit must be used.
- Tested on CB2974A board from 5MHz to 3GHz.
- Based on characterization data using the recommended applications circuit, at $V_{CC} = 3.3V$, $T_A = 25^\circ C$ and 800mV launch swing from the SDI cable driver
- Equalizer Pathological test signal was used.

Test Circuit

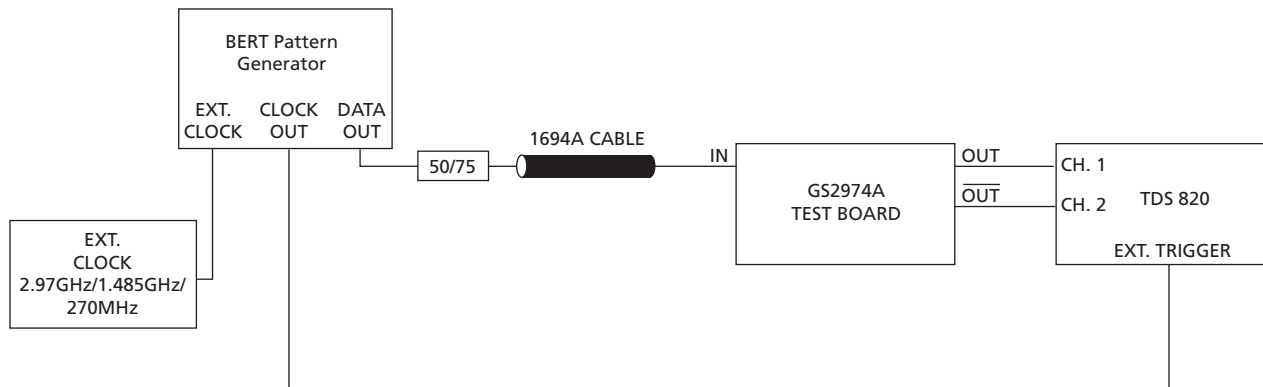


Figure 2-1: Test Circuit

3. Input/Output Circuits

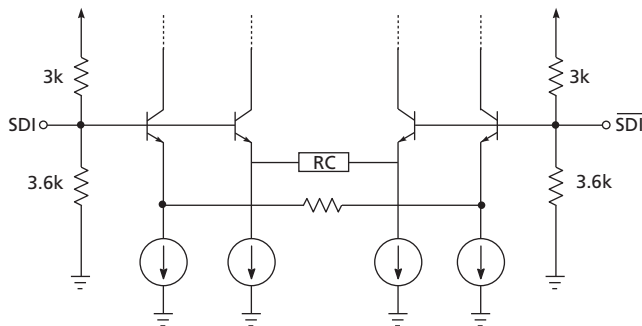


Figure 3-1: Input Equivalent Circuit

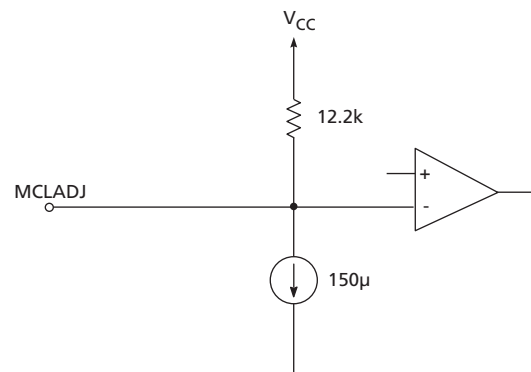


Figure 3-2: MCLADJ Equivalent Circuit

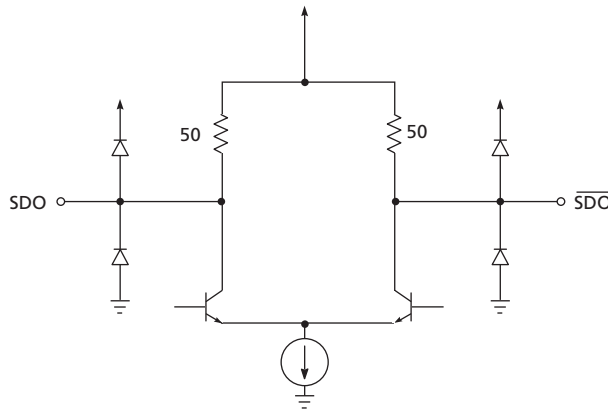


Figure 3-3: Output Circuit

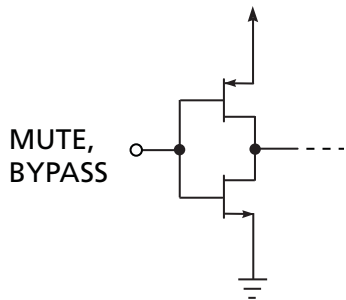


Figure 3-4: MUTE and BYPASS Circuits

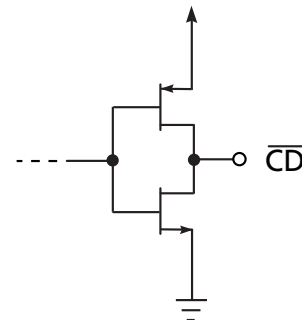


Figure 3-5: \overline{CD} Circuit

4. Detailed Description

The GS2974A is a high speed BiCMOS IC designed to equalize serial digital signals.

The GS2974A can equalize both HD and SD serial digital signals, and will typically equalize 120m of Belden 1694A cable at 2.97Gb/s, 200m at 1.485Gb/s and 350m at 270Mb/s. The GS2974A is powered from a single +3.3V power supply and consumes approximately 215mW of power.

4.1 Serial Digital Inputs

The serial data signal may be connected to the input pins (SDI/ \overline{SDI}) in either a differential or single-ended configuration. AC-coupling of the inputs is recommended, as the SDI and \overline{SDI} inputs are internally biased at approximately 1.8V.

4.2 Cable Equalization

The input signal passes through a variable gain equalizing stage whose frequency response closely matches the inverse of the cable loss characteristic. In addition, the variation of the frequency response with control voltage imitates the variation of the inverse cable loss characteristic with cable length.

The edge energy of the equalized signal is monitored by a detector circuit which produces an error signal corresponding to the difference between the desired edge energy and the actual edge energy. This error signal is integrated by both an internal and an external AGC filter capacitor providing a steady control voltage for the gain stage. As the frequency response of the gain stage is automatically varied by the application of negative feedback, the edge energy of the equalized signal is kept at a constant level which is representative of the original edge energy at the transmitter. The equalized signal is also DC restored, effectively restoring the logic threshold of the equalized signal to its correct level independent of shifts due to AC coupling. The digital output signals have a nominal voltage of 750mV_{pp} differential, or 375mV_{pp} single ended when terminated with 50Ω as shown in Figure 4-1.

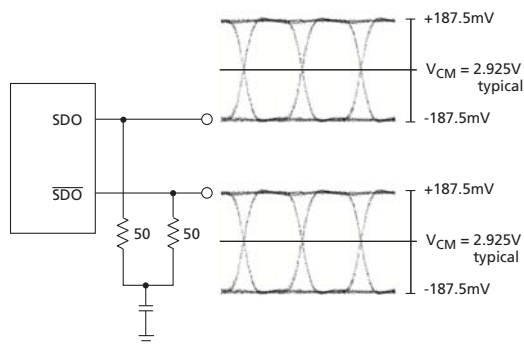


Figure 4-1: Typical Output Voltage Levels

4.3 Programmable Maximum Cable Length Adjust (MCLADJ)

For SMPTE 259M inputs, the GS2974A incorporates a programmable Maximum Cable Length Adjust (MCLADJ) threshold.

This feature can be useful in applications where there are multiple input channels using the GS2974A and the maximum gain can be limited to avoid crosstalk.

The MCLADJ pin acts to change the threshold of the Carrier Detect ($\overline{\text{CD}}$) pin. When the input signal drops below a certain threshold, the $\overline{\text{CD}}$ pin will be driven high, indicating that there is not a valid input signal. In order to enable automatic muting of the output of the GS2974A, the $\overline{\text{CD}}$ pin should be connected directly to the MUTE pin. In applications where programmable maximum cable length adjust is not required, the MCLADJ pin may be left unconnected.

This feature has been designed for use in applications such as routers, where signal crosstalk and circuit noise cause the Equalizer to output erroneous data when no input signal is present. The use of a Carrier Detect function with a fixed internal reference

does not solve this problem, since the signal to noise ratio on the circuit board could be significantly less than the default signal detection level set by the on chip reference.

NOTE: MCLADJ is only recommended for data rates up to 360Mb/s. For data rates above this, MCLADJ should be left floating.

4.4 Mute and Carrier Detect

The GS2974A includes a MUTE input pin that allows the application interface to mute the serial digital output at any time. Set the MUTE pin HIGH to mute SDO and \overline{SDO} . In this case, the outputs will mute regardless of the setting of the BYPASS pin.

A Carrier Detect output pin (\overline{CD}) indicates the presence of a valid signal at the input of the GS2974A. When \overline{CD} is LOW, the device has detected a valid input on SDI and \overline{SDI} . When \overline{CD} is HIGH, the device has not detected a valid input.

NOTE: This pin may be connected directly to the \overline{CD} pin to allow mute on loss of carrier.

NOTE: \overline{CD} will only detect loss of carrier for data rates greater than 19Mb/s. The \overline{CD} output pin may be connected directly to the MUTE input pin to enable automatic muting of the GS2974A when no valid input signal has been detected.

NOTE: If the maximum cable length is exceeded and the device is not in bypass mode the GS2974A will not assert the \overline{CD} pin even if a carrier is present.

Table 4-1: Mute Input Table

| Mute | Function |
|------|---|
| 0 | SDO and \overline{SDO} operate normally |
| 1 | SDO and \overline{SDO} are forced to a steady state |

Table 4-2: \overline{CD} Output Table

| \overline{CD} | Input Status |
|-----------------|---|
| 0 | Valid Input on SDI, \overline{SDI} pins |
| 1 | Input is not valid |

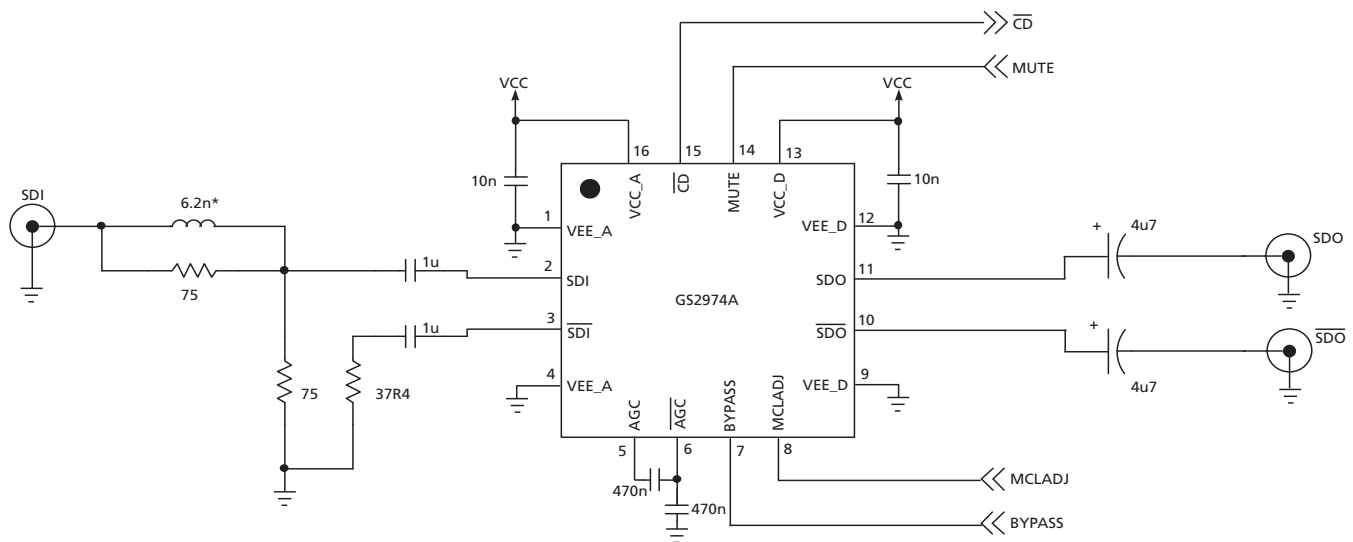
5. Application Information

5.1 PCB Layout

Special attention must be paid to component layout when designing serial digital interfaces for HDTV. An FR-4 dielectric can be used, however, controlled impedance transmission lines are required for PCB traces longer than approximately 1cm. Note the following PCB artwork features used to optimize performance:

- PCB trace width for HD rate signals is closely matched to SMT component width to minimize reflections due to change in trace impedance.
- The PCB ground plane is removed under the GS2974A input components to minimize parasitic capacitance.
- The PCB ground plane is removed under the GS2974A output components to minimize parasitic capacitance.
- High speed traces are curved to minimize impedance changes.

5.2 Typical Application Circuit

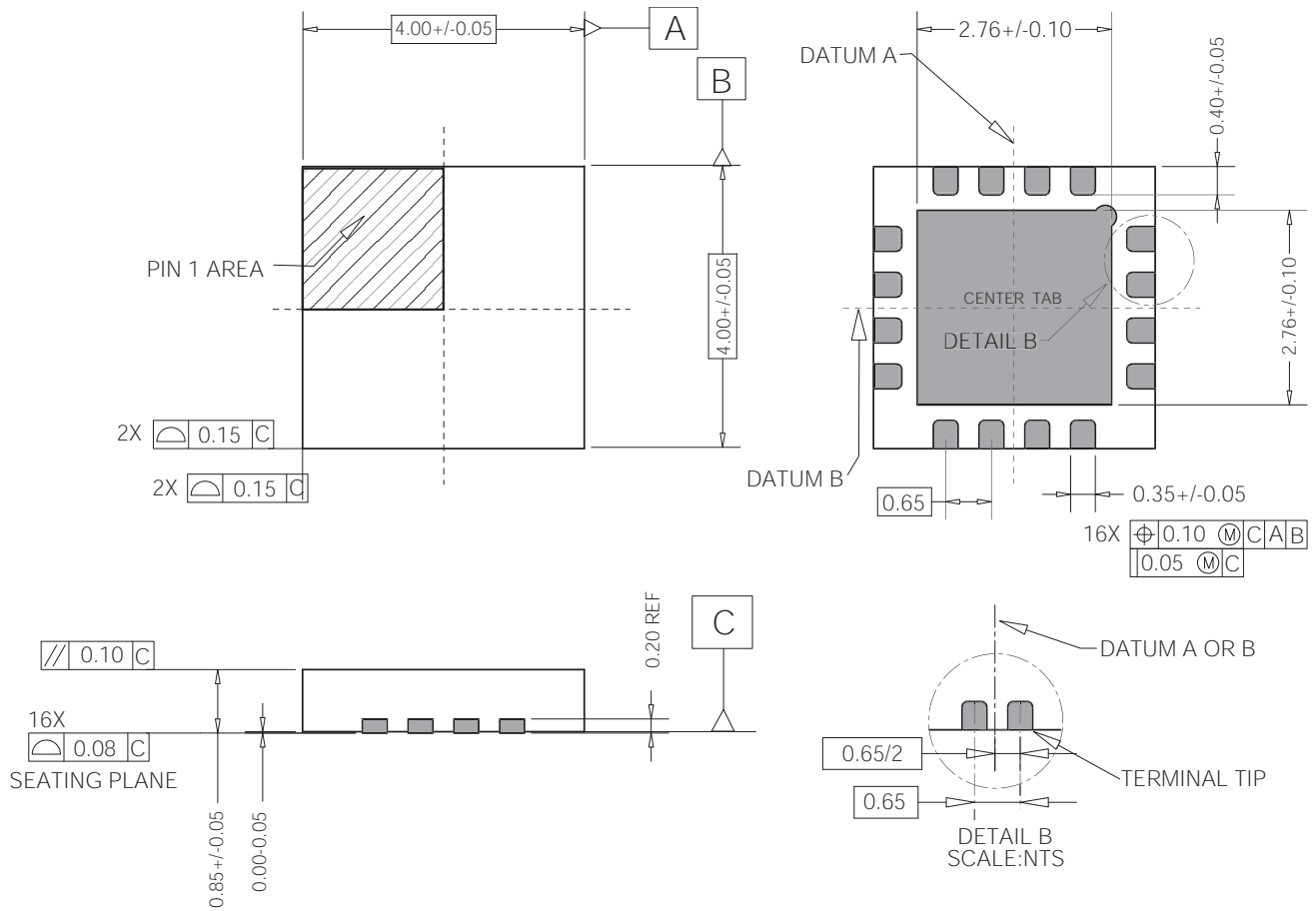


NOTE: All resistors in Ohms, capacitors in Farads, and inductors in Henrys, unless otherwise noted.
* Value dependent on layout

Figure 5-1: GS2974A Typical Application Circuit

6. Package & Ordering Information

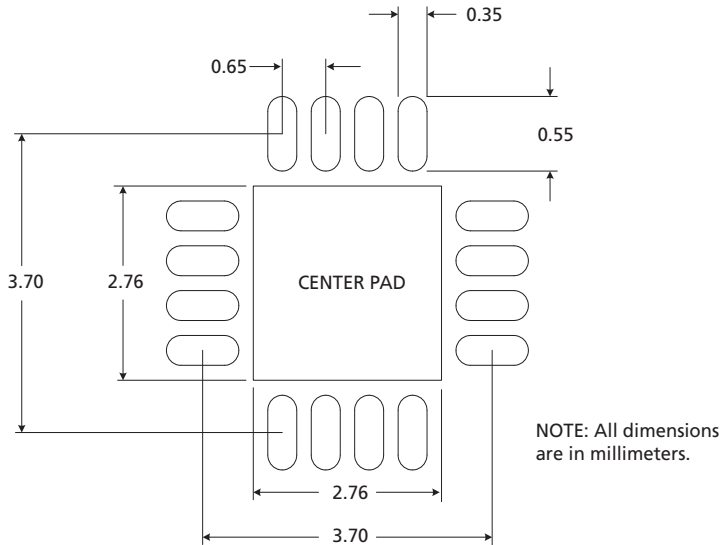
6.1 Package Dimensions



6.2 Packaging Data

| Parameter | Value |
|--|----------------------|
| Package Type | 4mm x 4mm 16-pin QFN |
| Package Drawing Reference | JEDEC M0220 |
| Moisture Sensitivity Level | 3 |
| Junction to Case Thermal Resistance, θ_{j-c} | 31.0°C/W |
| Junction to Air Thermal Resistance, θ_{j-a} (at zero airflow) | 43.8°C/W |
| Psi, ψ | 11.0°C/W |
| Pb-free and RoHS compliant | Yes |

6.3 Recommended PCB Footprint



The Center Pad should be connected to the most negative power supply plane for analog circuitry in the device (VEE_A) by a minimum of five vias.

NOTE: Suggested dimensions only. Final dimensions should conform to customer design rules and process optimizations.

6.4 Marking Diagram

Pin 1 ID



XXXX - Lot/Work Order ID

YYWW - Date Code

YY - 2-digit year

WW - 2-digit week number

6.5 Solder Reflow Profiles

The device is manufactured with Matte-Sn terminations and is compatible with both standard eutectic and Pb-free solder reflow profiles. MSL qualification was performed using the maximum Pb-free reflow profile shown in Figure 6-1. The recommended standard Pb reflow profile is shown in Figure 6-2.

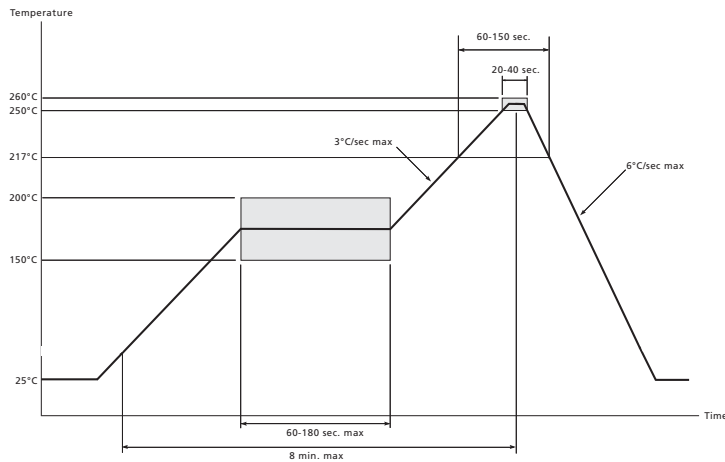


Figure 6-1: Maximum Pb-free Solder Reflow Profile (Preferred)

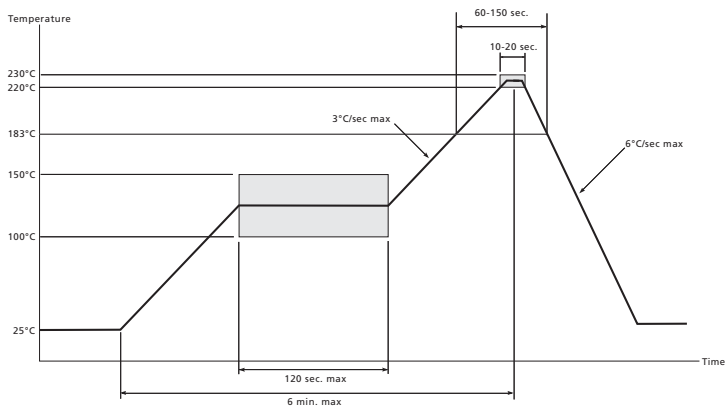


Figure 6-2: Standard Pb Solder Reflow Profile

6.6 Ordering Information

| | Part Number | Package | Temperature Range |
|---------|---------------|-----------------------------------|-------------------|
| GS2974A | GS2974ACNE3 | 16-pin QFN | 0°C to 70°C |
| GS2974A | GS2974ACTE3 | 16-pin QFN Tape & Reel (250pcs) | 0°C to 70°C |
| GS2974A | GS2974ACNTE3Z | 16-pin QFN Tape & Reel (2,500pcs) | 0°C to 70°C |

**DOCUMENT IDENTIFICATION
DATA SHEET**

The product is in production. Gennum reserves the right to make changes to the product at any time without notice to improve reliability, function or design, in order to provide the best product possible.

CAUTION

ELECTROSTATIC SENSITIVE DEVICES

DO NOT OPEN PACKAGES OR HANDLE EXCEPT AT A
STATIC-FREE WORKSTATION

GENNUM CORPORATION

Mailing Address: P.O. Box 489, Station A, Burlington, Ontario L7R 3Y3 Canada
Street Addresses: 4281 Harvester Road, Burlington, Ontario L7L 5M4 Canada
Phone: +1 (905) 632-2996 Fax: +1 (905) 632-2055
Email: corporate@gennum.com www.gennum.com

OTTAWA DESIGN CENTRE

232 Herzberg Road, Suite 101
Kanata, Ontario K2K 2A1
Canada

Phone: +1 (613) 270-0458
Fax: +1 (613) 270-0429

UNITED KINGDOM DESIGN CENTRE

North Building, Walden Court
Parsonage Lane,
Bishop's Stortford Hertfordshire, CM23 6DB
Great Britain

Phone: +44 (1279) 714170
Fax: +44 (1279) 714171

JAPAN KK

Shinjuku Green Tower Building 27F
6-14-1, Nishi Shinjuku
Shinjuku-ku, Tokyo, 160-0023
Japan

Phone: +81 (03) 3349 5501
Fax: +81 (03) 3349 5505
Email: gennum-japan@gennum.com
Web Site: <http://www.gennum.co.jp>

SNOWBUSH IP - A DIVISION OF GENNUM

439 University Ave. Suite 1700
Toronto, Ontario M5G 1Y8
Canada

Phone: +1 (416) 925-5643
Fax: +1 (416) 925-0581

Web Site: <http://www.snowbush.com>

**AGUASCALIENTES PHYSICAL DESIGN
CENTER**

Venustiano Carranza 122 Int. 1
Centro, Aguascalientes
Mexico CP 20000

Phone: +1 (416) 848-0328

GERMANY

Niederlassung Deutschland
Stefan-George-Ring 29
81929 München, Germany

Phone: +49 89 309040 290
Fax: +49 89 309040 293

Email: gennum-germany@gennum.com

UNITED STATES - WESTERN REGION

Bayshore Plaza
2107 N 1st Street, Suite #300
San Jose, CA 95131
United States

Phone: +1 (408) 392-9430
Fax: +1 (408) 392-9404

UNITED STATES - EASTERN REGION

4281 Harvester Road
Burlington, Ontario L7L 5M4
Canada

Phone: +1 (905) 632-2996
Fax: +1 (905) 632-2055

TAIWAN

6F-4, No.51, Sec.2, Keelung Rd.
Sinyi District, Taipei City 11502
Taiwan R.O.C.

Phone: (886) 2-8732-8879
Fax: (886) 2-8732-8870

KOREA

8F, Jinnex Lakeview Bldg.
65-2, Bangidong, Songpagu
Seoul, Korea 138-828

Phone: +82-2-414-2991
Fax: +82-2-414-2998

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